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OVERVIEW TO SILVICULTURAL SYSTEMS

IN THE CENTRAL ROCKY MOUNTAINS

by Wayne D. Shepperd and Robert R. Alexander

USDA Forest Service
Rocky Mountain Forest And Range Experiment Station
FORT COLLINS, COLORADO

RM-TT-1

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PREFACE

The practice of silviculture in the Central Rockies is a complex art. It requires that forest managers have a great deal of knowledge and information readily available to aid them in writing prescriptions and evaluating stands and treatments.

Scientists at the Rocky Mountain Forest and Range Experiment Station have developed a series of slide-tape programs to introduce you to the silvicultural systems currently in use for the major Central Rockies species. The Overview provides an elementary background regarding the factors you must consider when applying these systems. Additional slide-talks in this training series provide a more in-depth presentation of the silvics and silviculture of each of the major commercial species discussed here.

Accompanying each slide-tape is a booklet such as this, that duplicates the script. Please keep these booklets as handy desk-top references. They will help you recall the subjects presented in the talks and also locate additional literature in which you can find the original research covering the topics. You can obtain copies of the references cited by contacting the WESTFORNET library network , at 240 W. Prospect, Fort Collins, CO 80526.

This Overview slide-tape presentation has been distributed to all Forest Supervisor's offices in the Central Rocky Mountain area. Information concerning the purchase of additional copies of the slide-tape and booklet sets can be obtained from the Regional Offices for the Rocky Mountain and the Southwestern Regions, or by writing:

Public Affairs Officer
USDA Forest Service
Rocky Mountain Forest and Range Experiment Station
240 West Prospect
Fort Collins, CO 80526.

Other titles in this series include the following:

Silviculture of Spruce-Fir Forests in the Central Rocky Mountains (RM-TT-2)

Silviculture of Lodgepole Pine in the Central Rocky Mountains (RM-TT-3)

Silviculture of Ponderosa Pine in the Central & Southern Rockies. (RM-TT-4)

February 1983

Overview of Silvicultural Systems in the Central Rocky Mountains

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USDA Forest Service
RM-TT-1

[1]*Headquarters is in Fort Collins, in cooperation with Colorado State University.*

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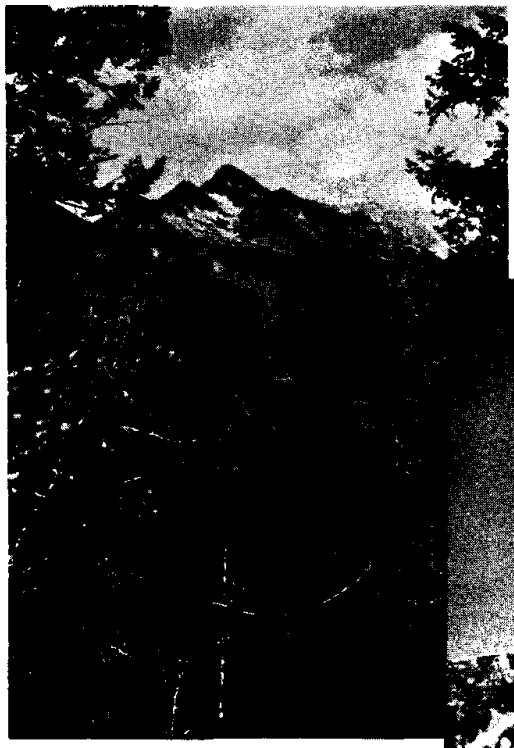

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1. . . . **2.** . . . **3.** . . . (musical interlude) . . .

4. If you're a forester *new* to the Central Rockies, you've already noticed that the silvicultural rules are *different* here. The climate, shallow soils, and rugged topography mean that you will need to pay *special attention* to some aspects of tree growth that you don't find elsewhere in the country.

2

5. In other areas of the nation, you don't find these extremes of topography and climate within such a small area. Here, you can go 50 feet over a ridge and enter a completely different microclimate. Soil type is usually the limiting factor elsewhere in the U.S. But here in the Central Rockies, it's principally temperature extremes and distribution of precipitation that determine what vegetation occurs where, how well it grows, and how it can be best managed.

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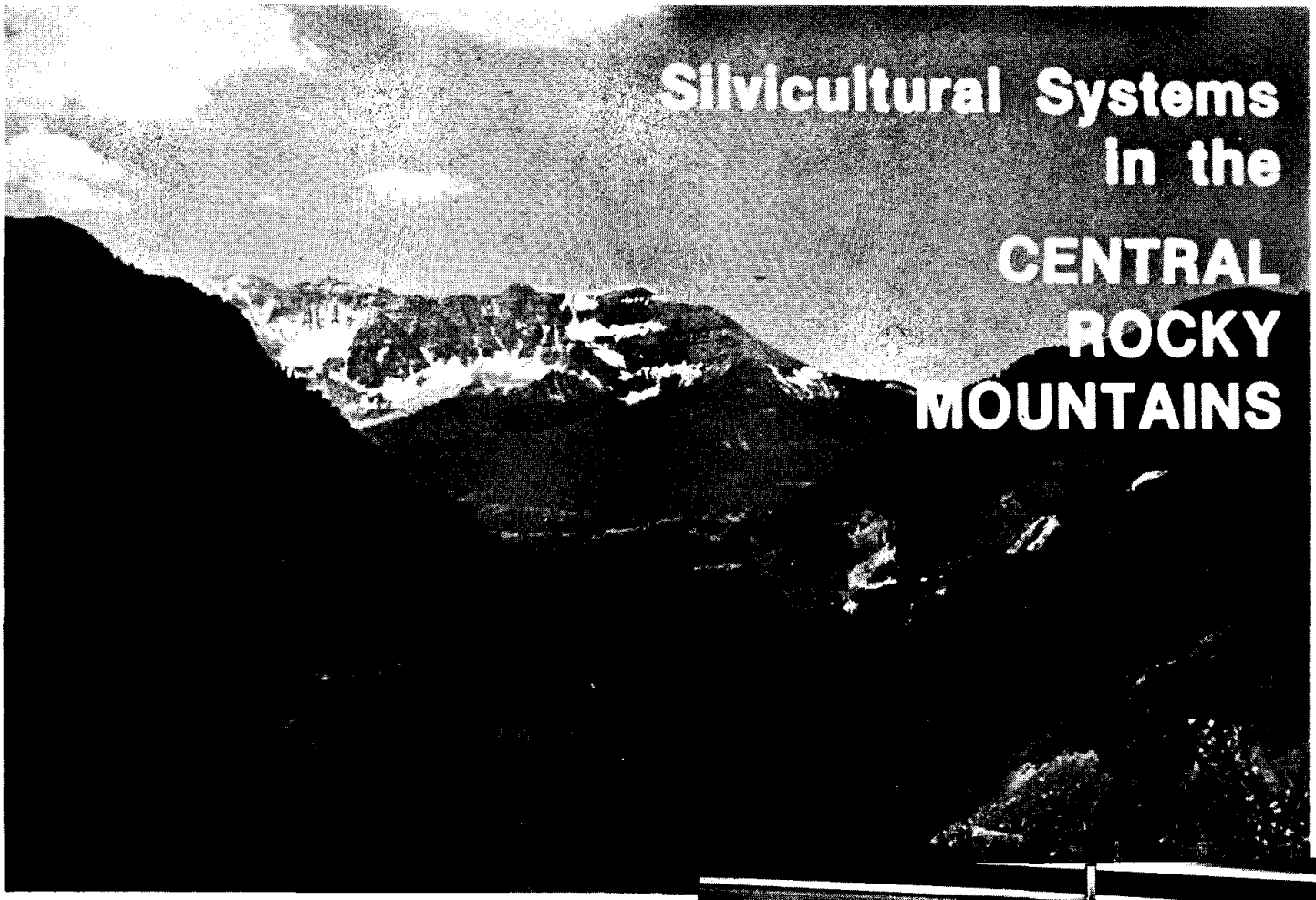

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7

6. In this slide-tape program, we'll give you an overview to silvicultural systems in the Central Rockies. In companion . . .

7. . . . slide-tape programs, we will focus on details pertinent to silviculture of either ponderosa, aspen, lodgepole, or spruce-fir forests in this section of the Rockies.

SILVICS OF:

SPRUCE-FIR

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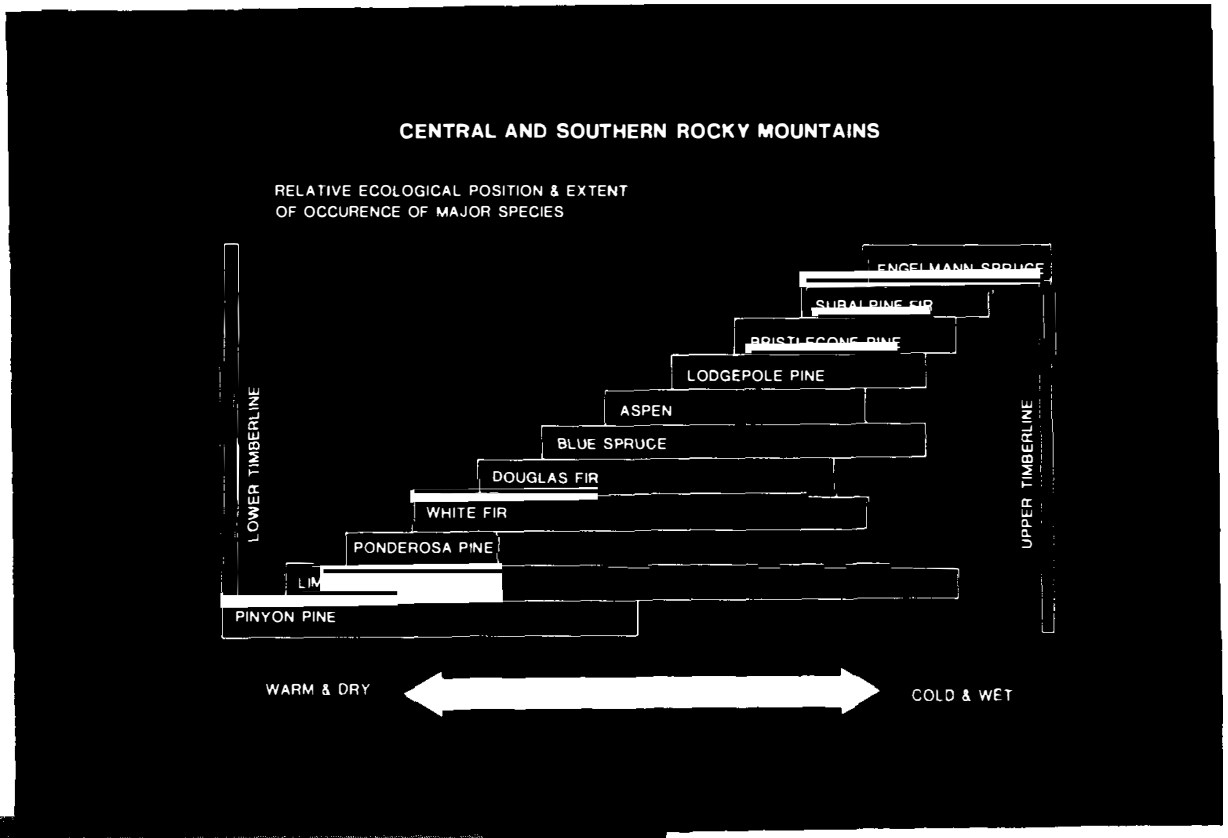

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8. Ecologically, Rocky Mountain species can be arranged on both an altitudinal and a moisture gradient. Of the species shown here, only four are included in this overview program. They are Engelmann spruce, subalpine fir, lodgepole pine, & ponderosa pine.

9. It's at these highest elevations in Colorado and Wyoming that you find Engelmann spruce and subalpine fir forests. These are the principal species occurring on north-facing slopes above 9,000 feet elevation;

10

11

12

10. . . . but above 10,000 feet, they occur in continuous stands. Spruce-fir forests are our most productive timber type and yield more water than any other forest type.

11. They also provide valuable wildlife habitat . . .

12. . . . and recreation and scenic areas.

LODGEPOLE PINE

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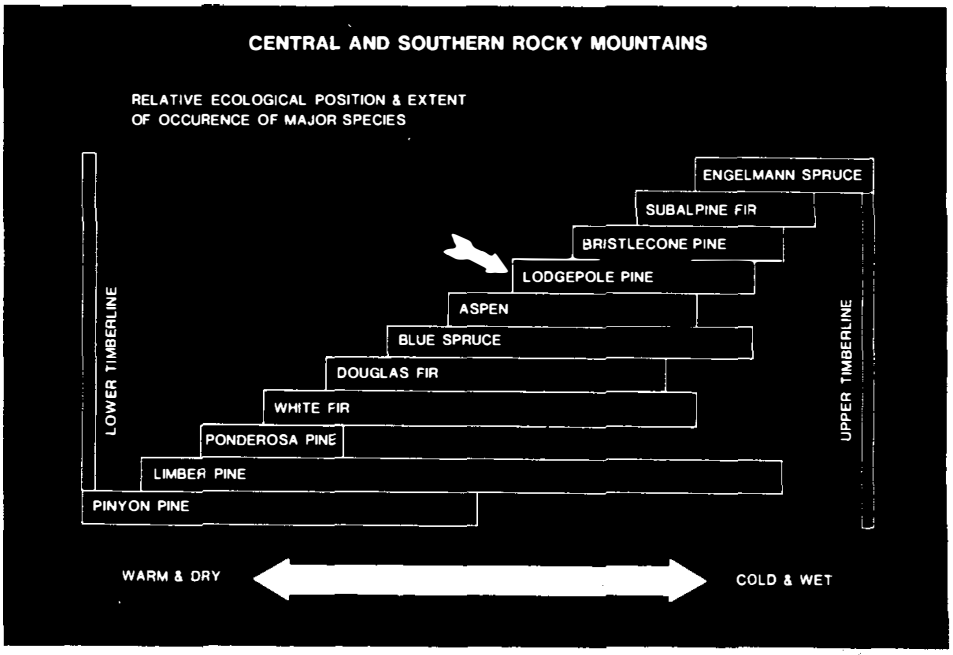

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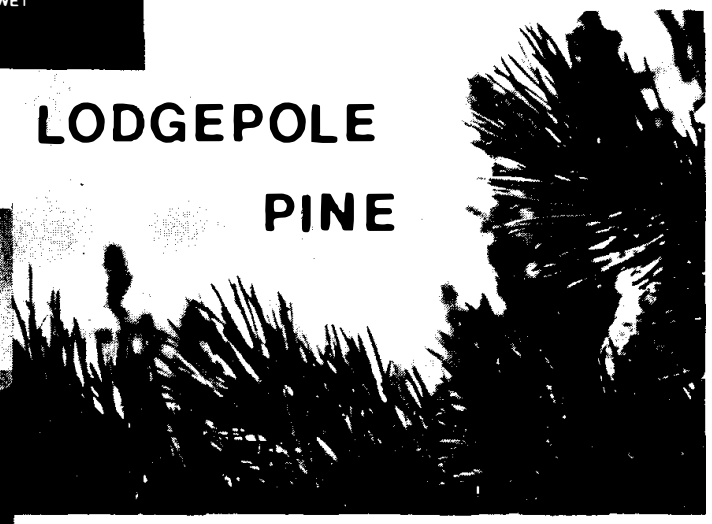

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13. At lower elevations, *lodgepole pine* forests take over. In this zone the climate is somewhat warmer and drier than that of higher spruce-fir zones, but the climate still has extreme fluctuations. Snowfall is the main source of moisture for both lodgepole pine and spruce-fir forests.

14. Lodgepole forests cover extensive areas between 7,500 and 10,500 feet elevation in Colorado and Wyoming . . .

15. . . . but they reach their maximum development in the upper montane and lower subalpine zones on south and west aspects between 8,500 and 10,000 feet. Lodgepole pine forests are the second largest timber resource in Colorado and Wyoming. Like spruce-fir forests, lodgepole pine forests occupy areas that are important for water yield, wildlife habitat, recreation, and scenic beauty.

PONDEROSA PINE

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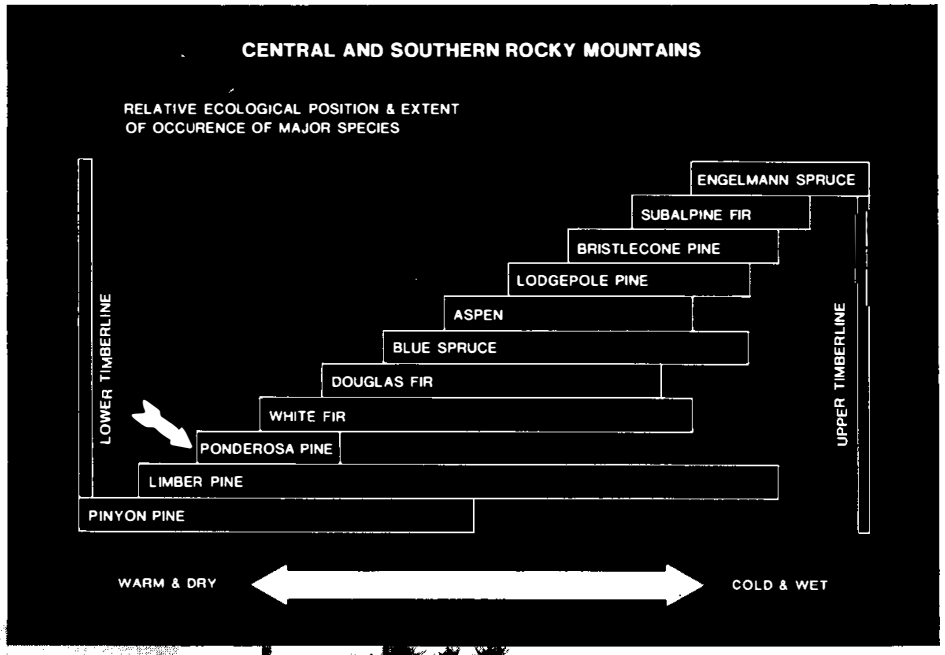

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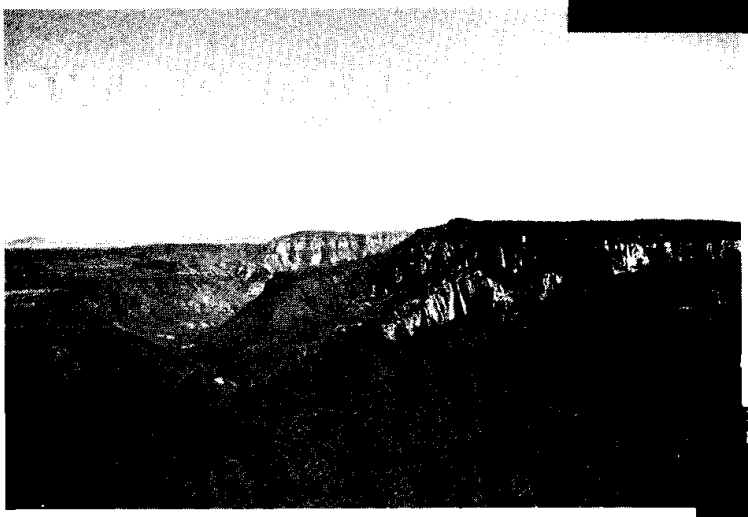

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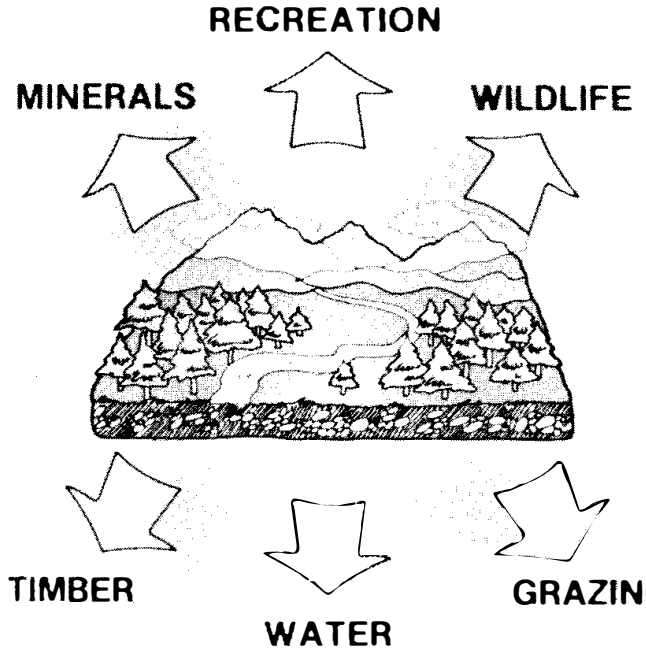
16. Further down in elevation and in an even drier climate, ponderosa pine forests occupy two major areas in the Central Rockies.

17. The first includes extensive forests along the Central and Southern Rockies. These forests are also important for wildlife habitat and recreational uses.

18. The second major concentration of ponderosa pine forests occurs in the Black Hills of South Dakota and Wyoming. Here the species covers about a million acres and forms a unique, isolated segment of the interior ponderosa pine type.

19. Management is simplified in the Black Hills because these forests reproduce easily and are free of dwarf mistletoe. Here ponderosa pine is the principal timber source and usually occurs in pure stands.



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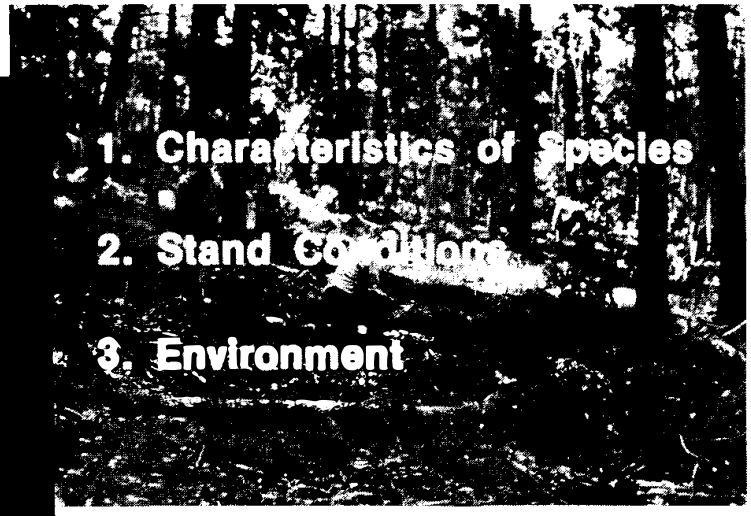
REGENERATION SILVICULTURE

A. Silvicultural Systems
B. Even-Aged Cutting Methods
C. Uneven-Aged Cutting Methods
D. Regeneration Triangle
E. Protecting Residual Stand



20. Today, in your management of these timber types, you must meet increased demands for forest resources without serious damage to the environment. Providing timber, wildlife habitat, recreation, grazing, water, and other forest products to the public, will almost always . . .

21. . . . require vegetation manipulation. Your degree of success depends on how well your management decisions conform . . .

22. . . . to the silvical characteristics of a particular species . . .

23. . . . to existing stand conditions . . .

24. . . . and to the environment in which the stand occurs. All of these affect the ability of any tree species to reproduce, survive, and grow. The other four slide-tapes in this series cover these three factors in more detail for each of the major commercial species in the Central Rockies.

25. Let's turn now to a review of silvicultural principals by discussing the two types of silvicultural systems, the cutting methods used in each, the three requirements for successful natural regeneration, and finally the factors to consider in protecting the residual overstory when partial cutting.

REGENERATION SILVICULTURE

26

26. Literally, silviculture means "to cultivate forests". Regeneration silviculture, then, is concerned with cultivating these forests to regenerate themselves *after* harvesting of timber is completed. In the Rocky Mountains, regeneration silviculture usually means cultivating old, previously unmanaged forests to regenerate into new stands which can be managed. There are two ways of managing forests: even-aged management and uneven-aged management.

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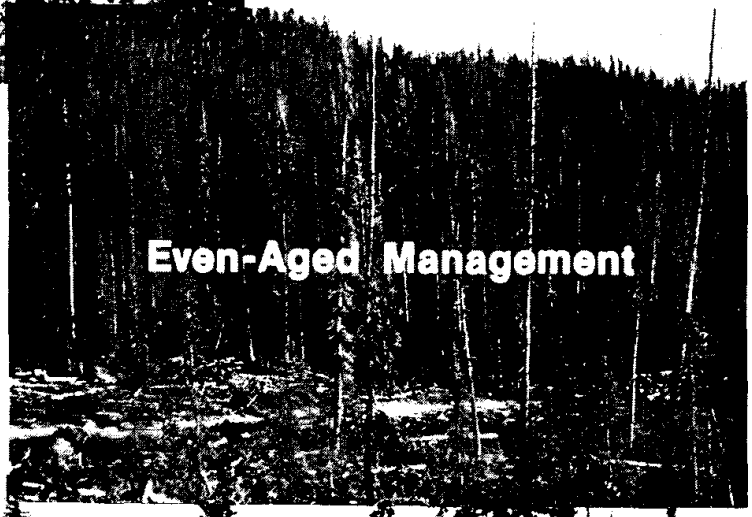

27. In even-aged management, a timber crop is raised to maturity and harvested, much like a crop of corn or grain. The stand is repeatedly regenerated to be again harvested at maturity.

28

28. On the other hand, uneven-aged management is just exactly what the name implies. Trees of various ages are harvested selectively over time while maintaining the original appearance of the stand.

EVEN-AGED CUTTING METHODS

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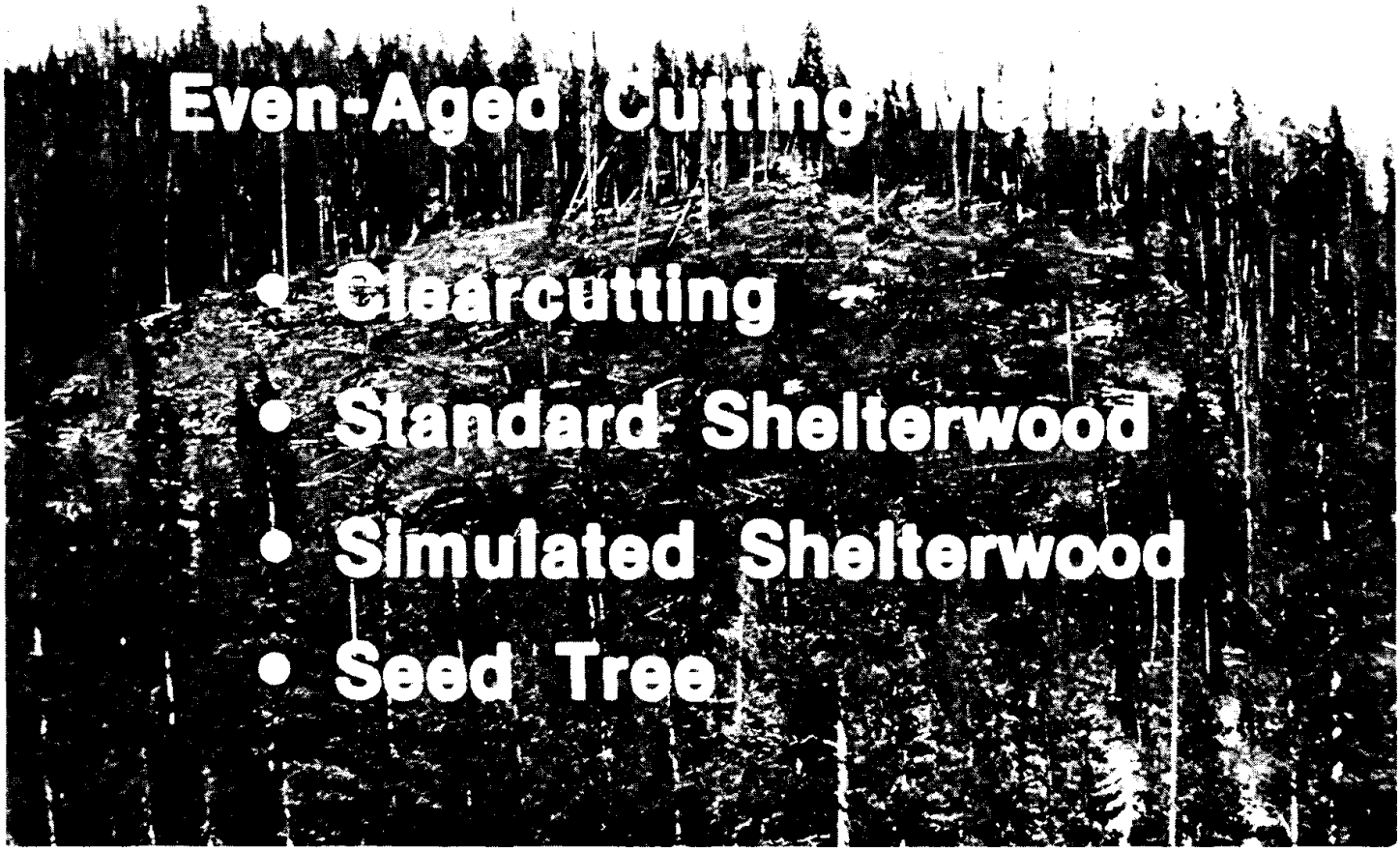

29. Even-aged systems include clearcutting, standard shelterwood, simulated shelterwood, and seed tree cutting.

Clearcutting

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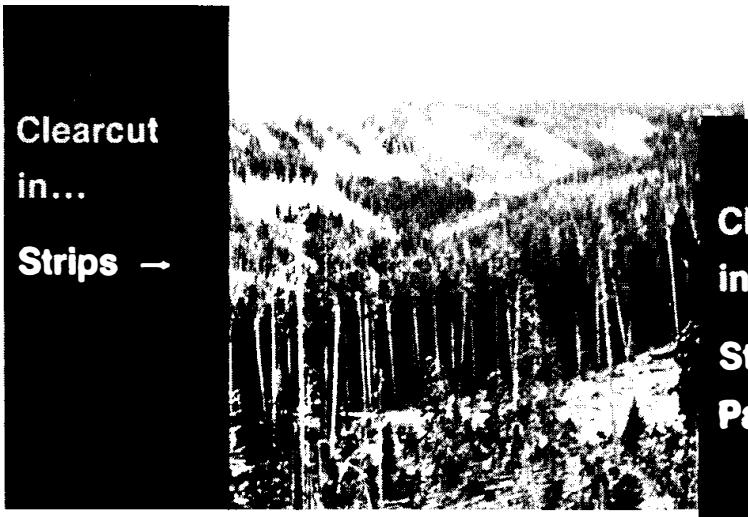

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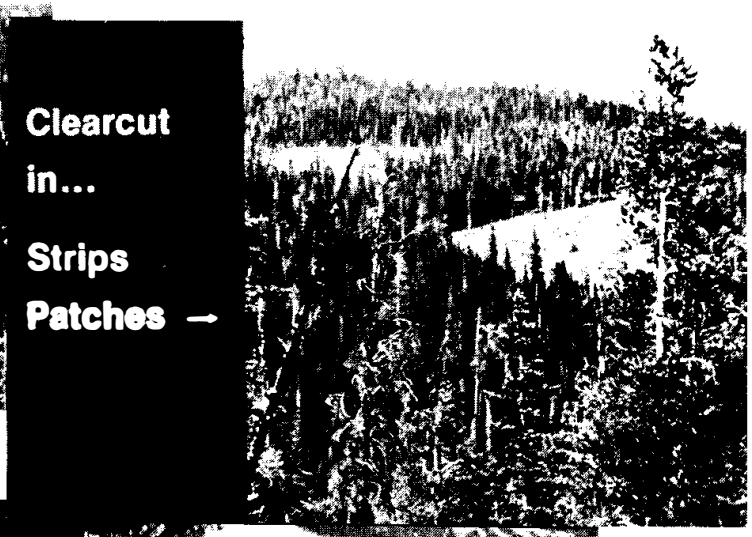

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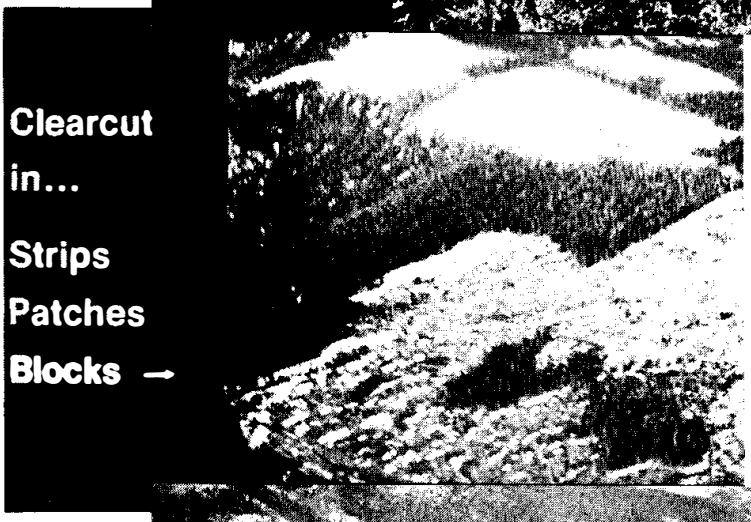

33

30. Clearcutting can be in strips . . .

31. . . . patches . . .

32. . . . or blocks. Clearcutting removes all the mature stand from an area in one cut. The harvested area is then prepared for natural or artificial regeneration.

33. A number of factors limit the size of clearcuts. Scenic quality, wind risk, and the effectiveness of seed dispersal often limit size and shape to small, irregular areas that blend into the scenery.

Standard Shelterwood

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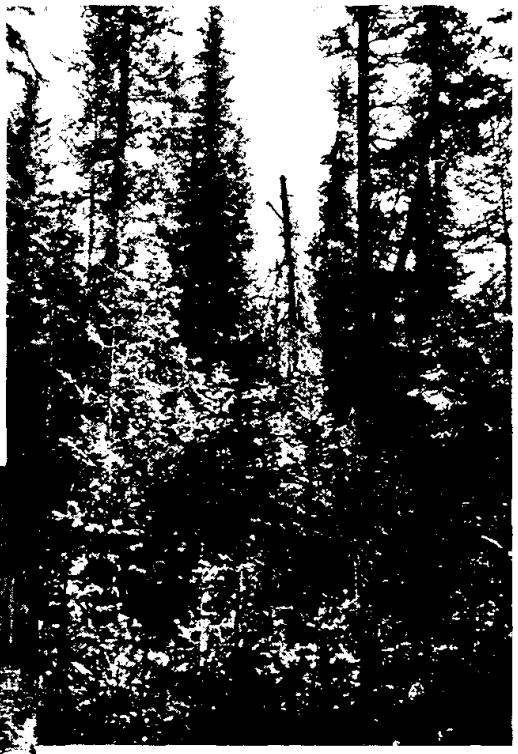
34. Another even-aged cutting method is the standard shelterwood. In this method, the mature stand is removed in a series of two or more cuts, usually over a period of 10 to 20 years. The purpose of the standard shelterwood is to assure even-aged natural regeneration under the protection of a partial canopy.

35. A uniform two-cut shelterwood is usually the most effective cutting method. However, a three-cut may be used in heavily stocked, mature stands where unusual problems are created by slash buildup, risks of windfall, and logging damage to reproduction.

36. The advantages of shelterwood cutting are many. It provides a continuous protection for the developing stand. It assures an adequate, well distributed seed source. It also provides fair control over development of competitive ground cover and good control over logging slash. After the final shelterwood removal, the young trees are released to develop into an even-aged stand.

Simulated Shelterwood

37



37. Simulated shelterwood cutting can be used in stands which contain a fully stocked understory of advanced regeneration, as shown here.

38. In a simulated shelterwood, all marketable trees in the overstory are removed in one or more cuts. This encourages the growth of the established, advanced reproduction and younger trees. This method is usually used to direct stand development toward even-aged management.

38

Seed-tree Cutting

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40

39. Seed tree cutting is another even-aged method which can have some application to Rocky Mountain species. This type of cut removes almost all marketable timber, usually in one operation. Several high quality trees of the desired species are left at intervals to reseed the area naturally.

40. A final cut removes seed trees when the new stand is established. The seed tree cut generally applies only to ponderosa pine in low wind risk areas.

UNEVEN-AGED CUTTING METHODS

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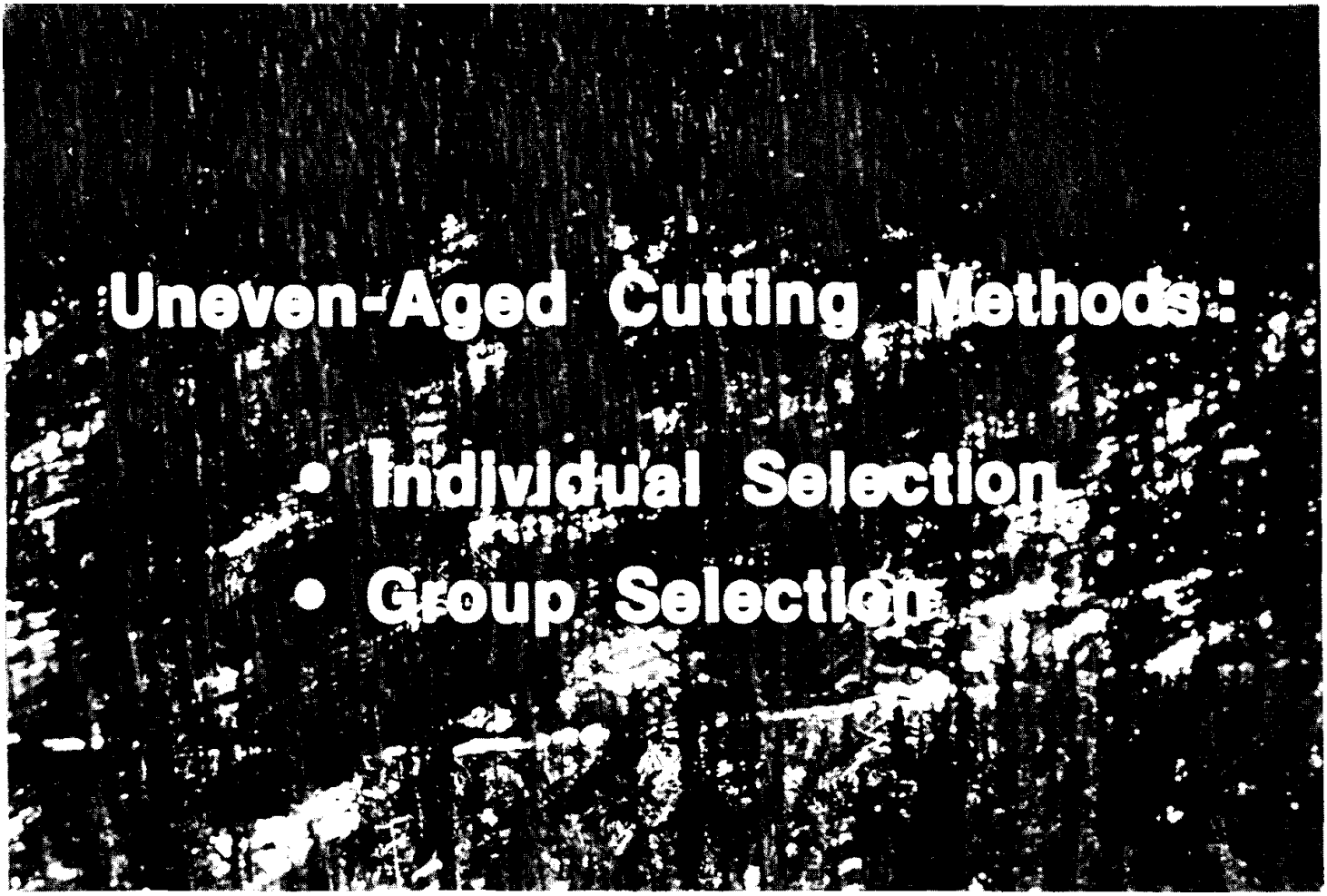

41. The types of cutting methods used in uneven-aged management are more limited. Individual tree selection and group selection are the two cutting methods available for you to use to manage forests in an uneven-aged mode.

Individual Tree Selection

42. Individual tree selection is best applied to uniformly spaced stands of all ages of *tolerant* species such as Engelmann spruce. By removing trees individually at intervals of time, you are encouraging continuous regeneration of the stand. This results in maintained stands which consist of intermingled trees of different ages and sizes.

43. You should also use individual tree selection in multiple-use areas where management objectives include the maintenance of mature-appearing forests. The amount of basal area that you should remove at each entry, the number of entries, and the selection of trees to be cut from each D.B.H. class, all depend upon stand characteristics and windfall risk. These factors are discussed in detail in the slide-tapes covering each species.

44. You can also use individual tree selection for improvement cuts in mature stands to maintain the health and appearance of the stand, and also to get the most from a few high-risk trees when the stands cannot be harvested on schedule.

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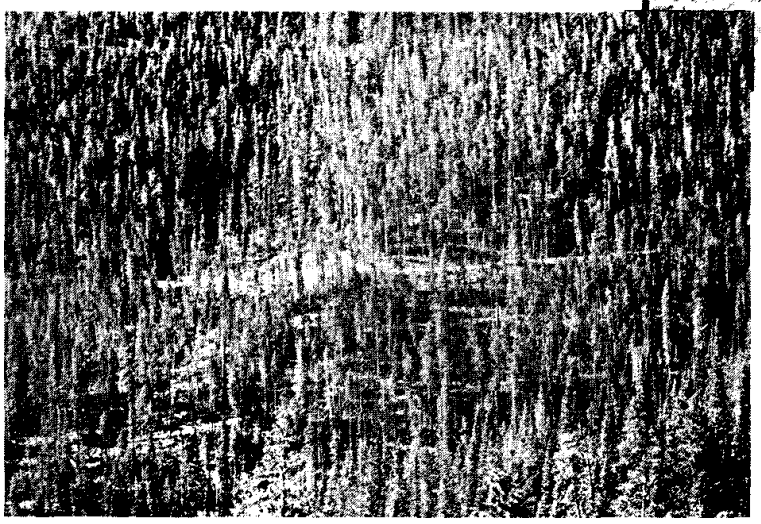

44

Group Selection Cut

45

45. The other uneven-aged cutting practice is the group selection cut. This type of cut removes mature trees in small groups at intervals of time, permitting establishment of reproduction in the openings. This results in an uneven-aged stand of even-aged groups of trees. Groups can range from a fraction of an acre up to 2 acres in size. This cutting method can be used to maintain a component of intolerant species, such as lodgepole pine, in the stand.

46

46. Naturally occurring groups should be treated as indicated by the needs of each stand. As a general rule, all trees in a group should be either cut or left.

47

47. Always remember that each of the Rocky Mountain timber species requires a particular treatment for a particular situation. Your choice of cutting method depends on management objectives and stand conditions. However, remember that windfall risk, disease, and insect susceptibility can limit your management options.

NATURAL REPRODUCTION TRIANGLE

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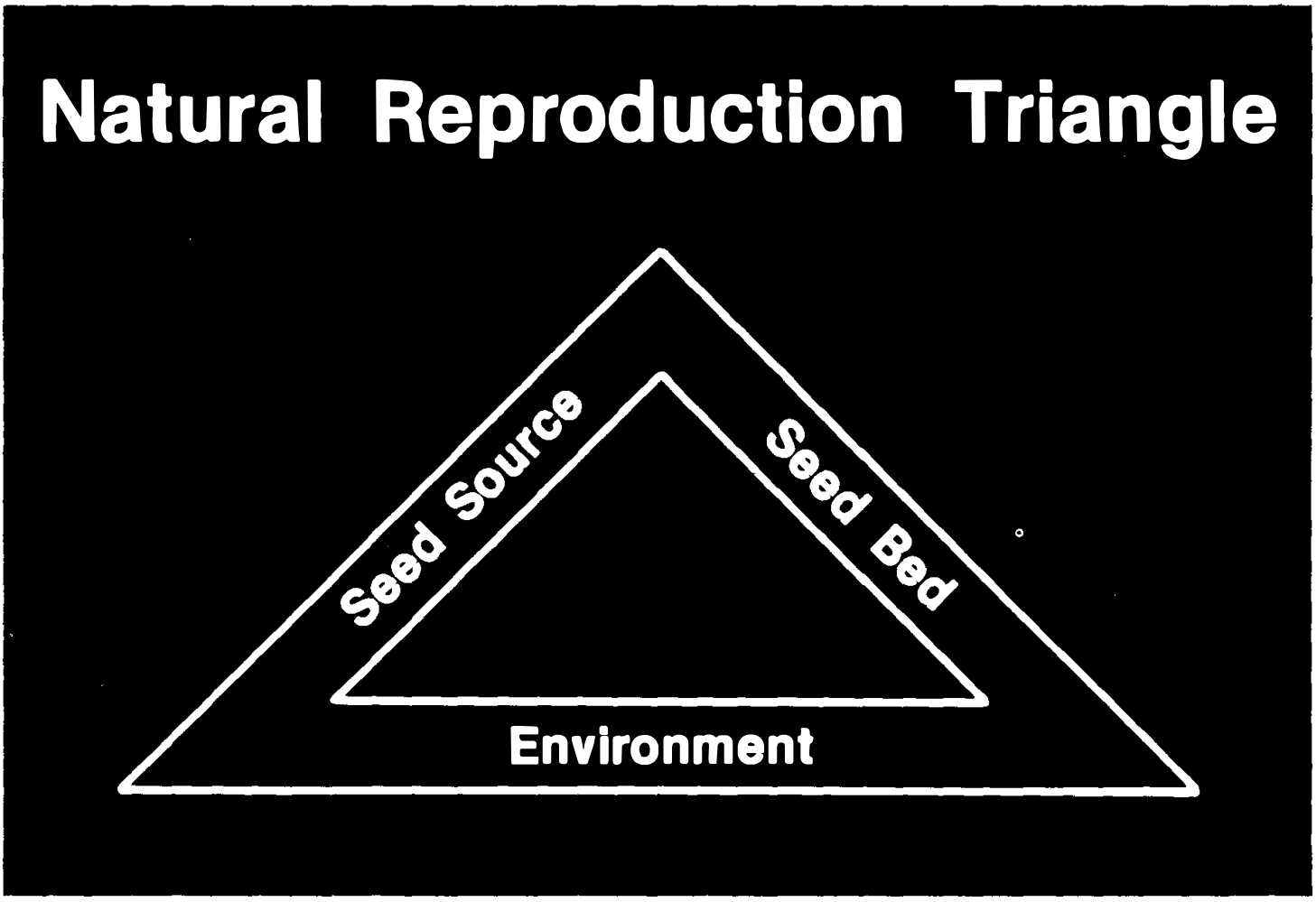
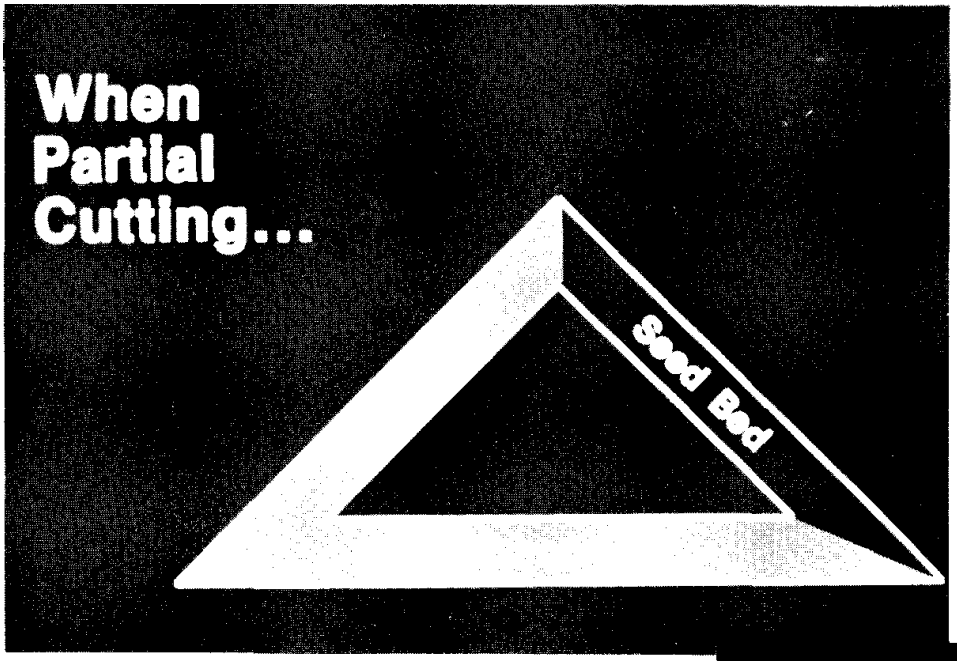


48. Regardless of the management scheme, what you are trying to accomplish is to provide three essential elements to achieve successful regeneration. These include an ample seed source, a suitable seedbed, and environmental conditions that encourage establishment and growth of seedlings. These three factors make up the "regeneration triangle." You cannot achieve successful regeneration without all three elements.

WHEN PARTIAL CUTTING



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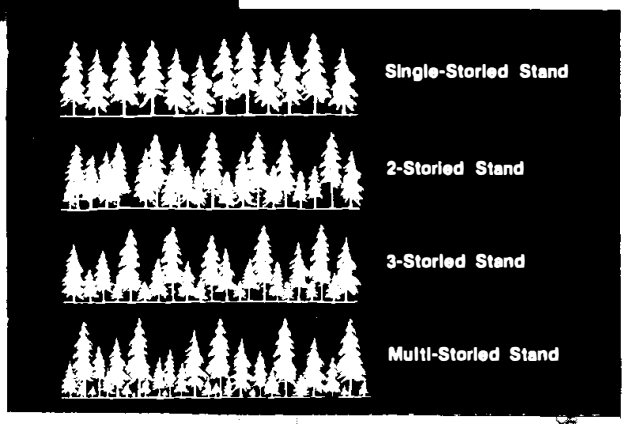

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49. Where partial cutting is used, original stand structure can be very important in determining the cutting method you should use to provide both suitable seed source and environment.

50. Stands can be one, two, three, or multistoried. You'll find that multistoried stands frequently have a manageable stand of advanced growth. In such cases regeneration of the stand has already been accomplished and your job is to protect it while removing the overstory.

51

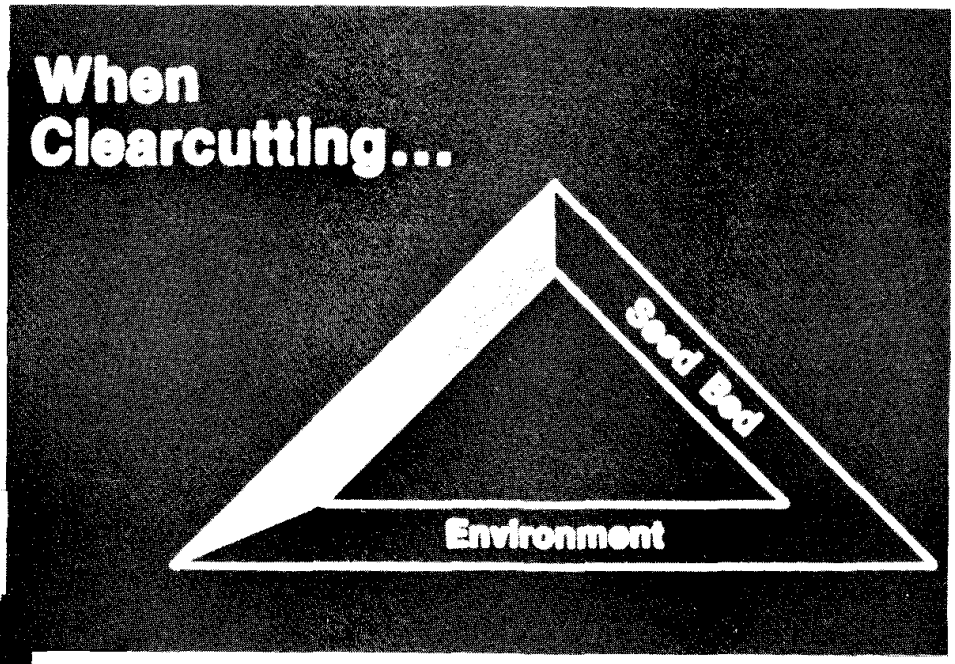
51. You'll find that multistoried stands are usually the most windfirm, even if they have developed from the deterioration of single or two storied stands. In areas where the windfall risk is below average, you'll have a lot of flexibility in your choice of harvesting methods to use in these stands.

52. Single-storied stands are usually the *least* wind-firm because trees have developed together over a long period of time and mutually protect each other.

52

WHEN CLEARCUTTING

53



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53. Where *clearcutting* is used, the critical element in the regeneration triangle becomes the seed source. You need to consider two factors to provide it. The first is size of seed, and the second, the size of the opening. Cutting units must be designed to maximize seed dispersal of the species being cut.

54. For example, spruce-fir seeds are light-weight and easily dispersed by wind and gravity. (Because of this, openings can be larger, but only where wind risk conditions permit.)

55. Openings in spruce-fir forests should not be greater than about 400 ft, should be irregular in shape, and blend into the landscape. If larger openings are cut, the interior of the opening must be planted.

56. On the other hand, ponderosa pine seeds are large and heavy and are not easily dispersed by wind. In this case, seed scattered on the ground during logging, or other factors, may become more important means of dispersing seed than natural dissemination from standing trees after cutting.

56

57

57. With lodgepole pine, cone serotiny determines the maximum size of openings which can be cut. If cones are *open,* the spruce-fir maximum limit can be used. If cones are *closed,* the seed is disseminated from logging slash. In the latter case, slash treatment — rather than the size of opening — becomes the critical factor in obtaining successful regeneration.

WHEN PARTIAL OR CLEARCUTTING

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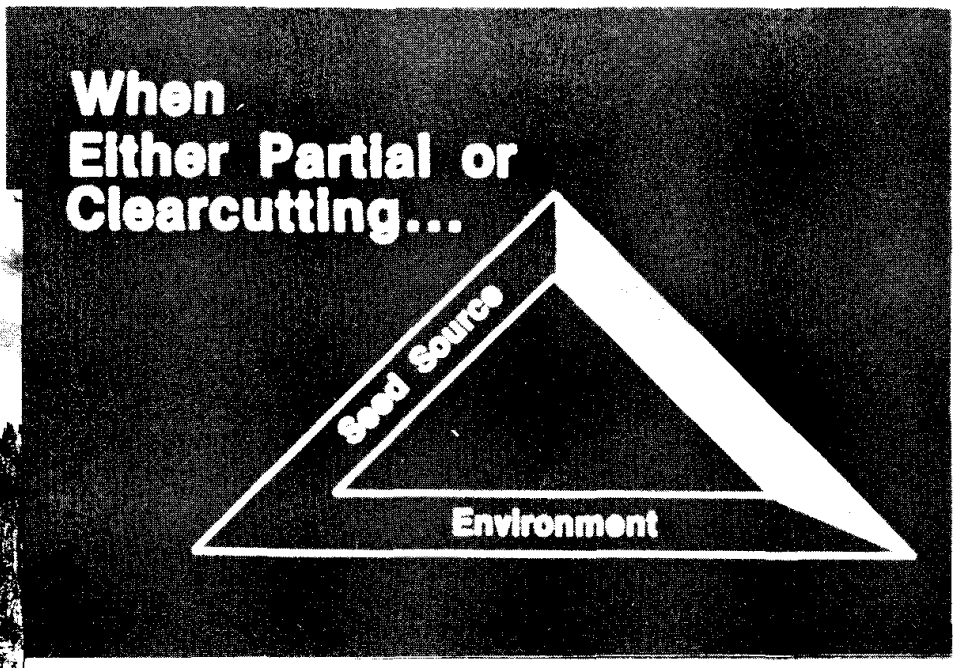

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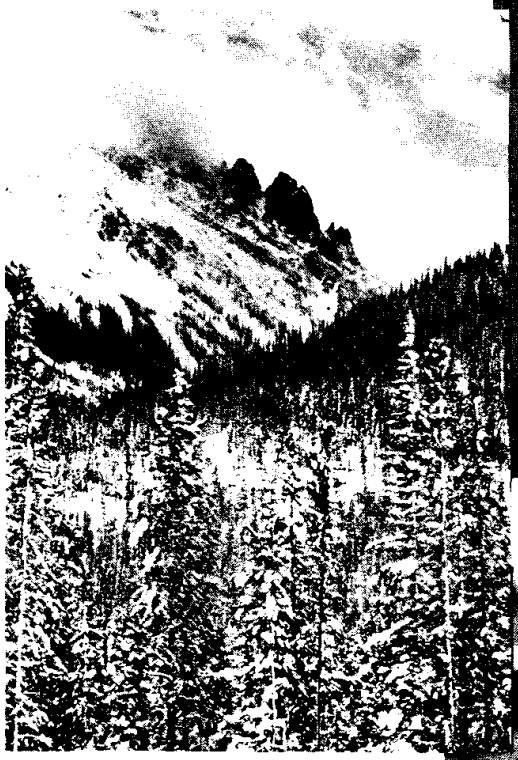

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58. Remember that in either partial or clear cuts, you'll also have to provide a suitable *seedbed* to achieve successful regeneration.

59. One of the factors affecting suitability of the seedbed is the type of the precipitation. In the Rockies, the majority of the precipitation comes as snowfall.

60. Summer can be cool and humid from a regeneration standpoint. But, newly germinated seedlings often can't reach moisture from winter snows stored deeper in the soil. This one factor alone can be most limiting to seedling establishment and survival. All conifers do best on a seedbed with a constant supply of moisture.

Slash Disposal

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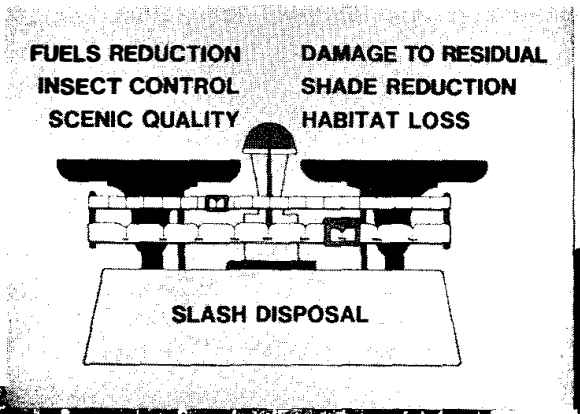

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61. Because of this, slash disposal and seedbed preparation are extremely important. There are . . .

62. . . . several general factors to consider when dealing with slash disposal. First, slash can provide beneficial shade for germination and seedling establishment.

63. On the other hand green slash — eight inches in diameter or larger — provides habitat for beetles; in heavy concentrations, slash can obstruct natural seedling development . . .

64. . . . and it often creates adverse visual impact and may create an unnecessary fire hazard.

65. You'll find that most equipment available today for slash disposal does not work well in shelterwood cuttings. If slash is heavy you may have to plan for some hand piling or scattering. If a group selection cut is made in an area where there is no stand of advanced reproduction, dozers equipped with brush blades can be used to concentrate slash for burning in openings.

66. Piles should, however, be kept small. Slash burned in large concentrations as shown here, often creates enough heat in the soil to initially suppress plant growth.

Seedbed Preparation

67. After slash disposal, it may be necessary to prepare a suitable seedbed, especially in partial cuts such as shelterwood and group cuts. If at least 40 percent of available ground surface is not exposed mineral soil, then additional seedbed preparation will be needed.

67

68. You can expose mineral soil by broadcast burning, or by mechanically scarifying the ground surface, sometimes in connection with slash disposal. However, broadcast burning of slash cannot be used in lodgepole pine stands with closed or serotinous cone habit, because the seed will be destroyed.

68

69. Several techniques are available to mechanically prepare a seedbed. Tractor walking is one alternative in areas where slash concentrations are not too heavy.

69

70. Here is an area after the tractor has walked down the slash. Note the reduction of fine fuels and exposure of mineral soil. Many pieces of broken slash are now available to provide shade for planting Engelmann spruce seedlings.

70

71

72

71. Roller choppers can also be used to crush slash into the ground.

72. This lodgepole pine seedbed was prepared by a roller chopper which exposed mineral soil and destroyed some competing vegetation, while leaving erosion protection. At least 40 percent of the area should be left as exposed mineral soil.

73. But remember, as with slash disposal, equipment today is often too large to work well around standing trees in partial cut areas.

74. Smaller machines equipped with suitable attachments should be used to minimize damage to remaining trees.

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REGENERATION SILVICULTURE

A. Silvicultural Systems

B. Even-Aged Cutting Methods

C. Uneven-Aged Cutting Methods

D. Regeneration Triangle

E. Protecting Residual Stand

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75. As you've already seen, a number of cutting practices can be used with Rocky Mountain conifers. However, choosing a cutting method is only a first step. A number of other factors must be considered when implementing the prescription. In partially cut stands, . . .

76. . . . protecting uncut trees from logging damage should be your main concern, especially in the final overstory removal. This includes protecting marketable trees left after shelterwood cutting, . . .

77. . . . and protecting advanced reproduction in both shelterwood and group selection cutting where there is an acceptable stand of regeneration to be managed. Remember, protection begins even before the first cut with a well designed logging plan.

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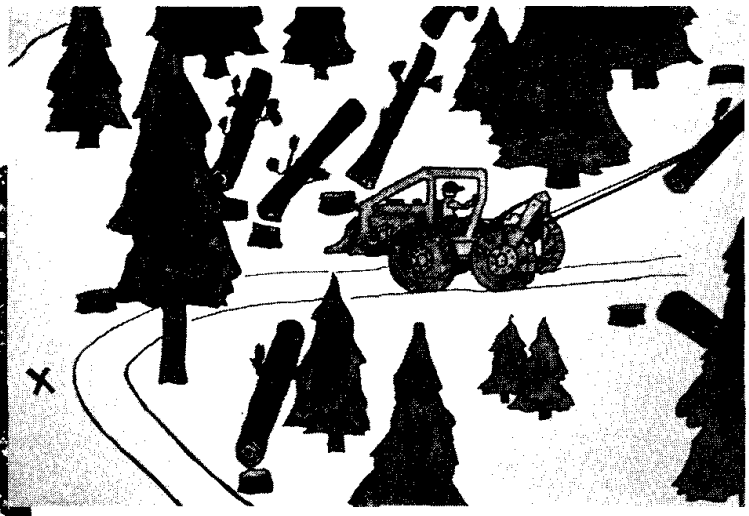

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78. To minimize damage, skidroads should be laid out approximately 200 feet apart, although this distance depends on the topography. And they should be marked on the ground.

79. Skidroads should be kept narrow and located so they can be used to move logs out of the stands during each cut throughout the rotation. You will need to closely supervise logging to restrict the travel of skidding and other logging equipment to skidroads.

80. In shelterwood cutting, trees should be felled into openings as much as possible using a herringbone pattern. By felling trees this way, logs can be pulled onto skidroads with minimum disturbance. In some situations it may be necessary to deviate from the herringbone pattern in order to drop trees into openings. If this happens, logs should be bucked into short lengths to reduce skidding damage.

81. Despite all your precautions in felling and skidding, some standing trees may still be damaged. Check to see if damaged trees are windfirm. If they are, leave them standing.

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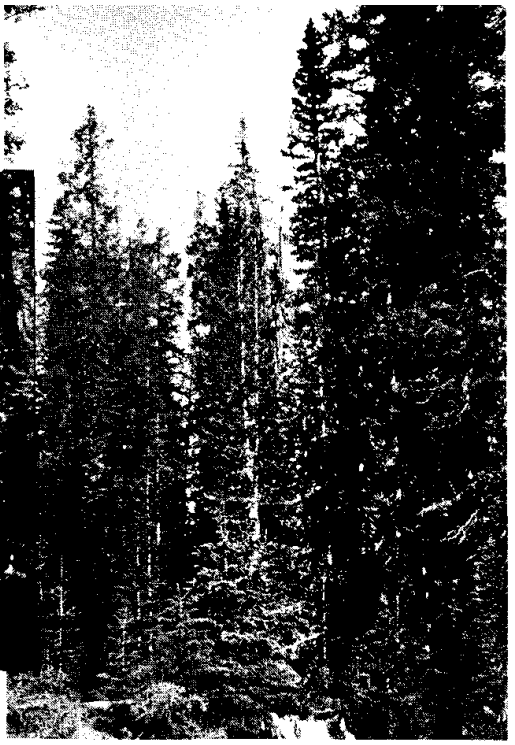

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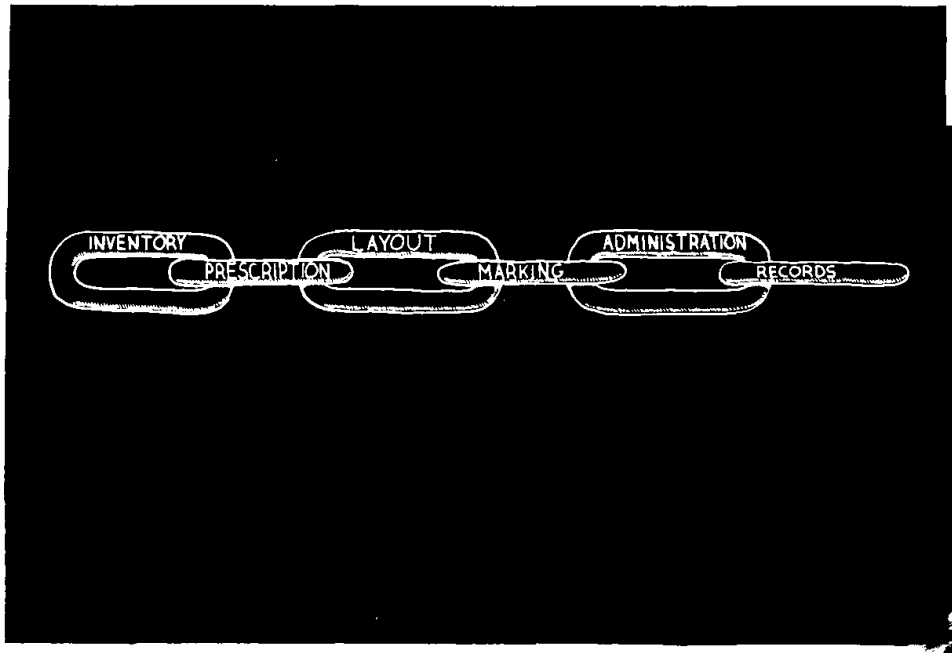
82. The herringbone pattern can also be used in group selection to avoid damage to manageable stands of advanced reproduction, as shown here.

83. If this is not the case, all trees should be felled into the openings.

84. It's important to remember that both shelterwood and group selection cuttings require close coordination between felling and skidding, because it may be necessary to fell and skid one tree before another tree is cut, or to fell and remove trees in 2 or more stages.

85. Sometimes it's necessary to change direction of skid trails. If this happens marked trees or high stumps should be left to serve as pivot points or rub trees during logging. These will be removed later.

CONCLUSION



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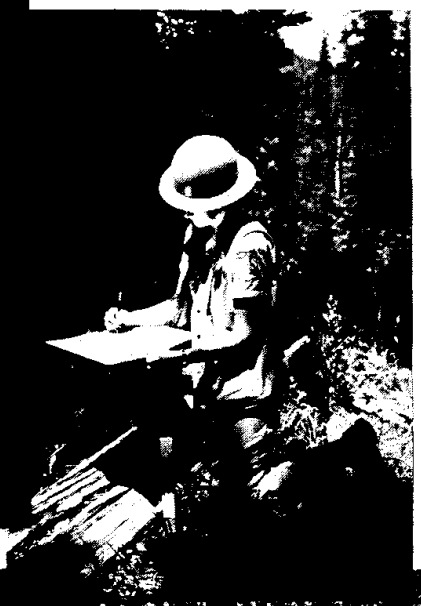

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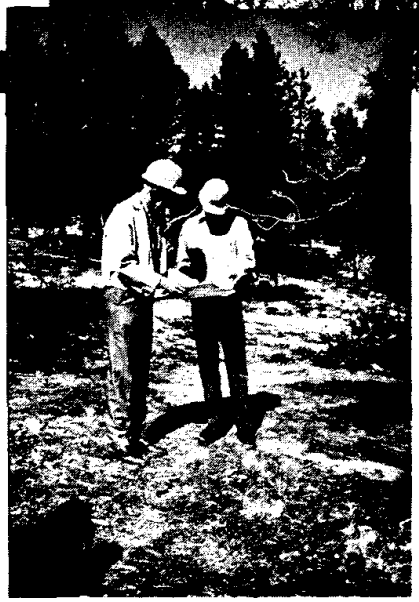
86. As you have seen throughout the program, there are several operations crucial to successful silvicultural treatment. A breakdown or failure of any part will result in failure of the entire process.

87. An accurate prescription is not possible without accurate inventory information. The best prescription will be ineffective if improperly applied.

88. Sale layout and marking personnel need to fully understand the intentions of your prescription.

89. Timber sale administrators have to ensure that logging activities can and do meet your prescription requirements.



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90. Finally, accurate long-term records need to be kept to ensure that future activities within a stand are consistent with your original prescription and that activities are properly scheduled and correctly applied.

91. It takes the involvement of your entire team to produce an effective timber management plan and to keep it on track.

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92. This program introduces a series of slide tapes giving the state of the art of silviculture of timber species in the Central Rocky Mountains. You may obtain other slide programs in this series, or publications dealing with these subjects by contacting the Forest Service headquarters of the Rocky Mountain Forest and Range Experiment Station in Fort Collins, Colorado.

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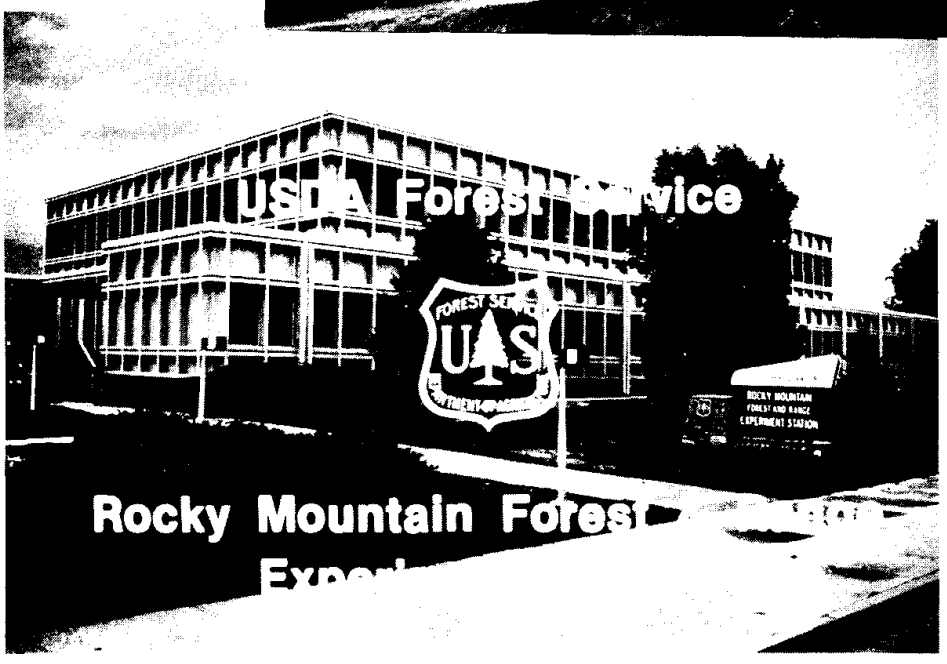

FOR FURTHER READING:

1. Alexander, Robert R.
   1974. Silviculture of central and southern Rocky Mountain forests: A summary of the status of our knowledge by timber types. USDA For. Serv. Res. Pap. RM-120, 36 p.

   Summarizes a series of comprehensive reports on the silviculture of lodgepole pine, ponderosa pine, mixed conifer, and spruce-fir timber types. Includes what is known, what can be recommended, and what additional information is needed for each timber type.

2. Alexander, Robert R.
   1974. Silviculture of subalpine forests in the central and southern Rocky Mountains: The status of our knowledge. USDA For. Serv. Res. Pap. RM-121, 88 p.

   The status of our knowledge about the silviculture of subalpine forests in Wyoming, Colorado, and New Mexico is described. The ecology and silvics of the Rocky Mountain subalpine zone are briefly described, followed by in-depth reviews of the spruce-fir type and lodgepole pine type. The relevant literature is included, along with unpublished research, observations, and experience. Research needs are considered, as well as what is already known.

3. Boldt, Charles E., and James L. Van Deusen.
   1974. Silviculture of ponderosa pine in the Black Hills: The status of our knowledge. USDA For. Serv. Res. Pap. RM-124, 45 p.

   This paper, intended as a guide for professional foresters, describes major silvicultural conditions likely to be encountered in the Black Hills, reasonable treatment options, and probable results and implications of these treatments. It also describes silvical characteristics and behavior of Black Hills ponderosa pine, and a variety of proven silvicultural tools.

4. Schubert, Gilbert H.
   1974. Silviculture of southwestern ponderosa pine: The status of our knowledge. USDA For. Serv. Res. Pap. RM-123, 71 p.

   Describes the status of our knowledge of ponderosa pine silviculture in the southwestern States of Arizona, Colorado, New Mexico, and Utah. Economic value, impact on other uses, and the timber resource are discussed first, followed by ecological background, site quality, growth and yield, and silviculture and management. Relevant literature is discussed along with observations, experience, and results of unpublished research. Treatise is intended to serve as a reference tool for guidance in making management decisions and prescribing silvicultural treatments. Research needs are also considered.

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